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School code

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School name

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Given name/s

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Family name

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Attach your
barcode ID label here

Book

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of

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books used

External assessment 2022

Question and response book

Engineering

Time allowed

- Perusal time — 10 minutes
- Working time — 120 minutes

General instructions

- Answer all questions in this question and response book.
- QCAA-approved calculator permitted.
- Protractor and ruler required.
- QCAA formula and data book provided.
- Planning paper will not be marked.

Section 1 (10 marks)

- 10 multiple choice questions

Section 2 (41 marks)

- 7 short response written questions

Section 3 (34 marks)

- 5 short response calculation questions





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THIS PAGE WILL NOT BE MARKED



Section 1

Instructions

- Choose the best answer for Questions 1–10.
- This section has 10 questions and is worth 10 marks.
- Use a 2B pencil to fill in the A, B, C or D answer bubble completely.
- If you change your mind or make a mistake, use an eraser to remove your response and fill in the new answer bubble completely.

	A	B	C	D
Example:	<input checked="" type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

	A	B	C	D
1.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
2.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
3.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
4.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
5.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
6.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
7.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
8.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
9.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
10.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

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Section 2

Instructions

- Write using black or blue pen.
 - Respond in paragraphs consisting of full sentences.
 - If you need more space for a response, use the additional pages at the back of this book.
 - On the additional pages, write the question number you are responding to.
 - Cancel any incorrect response by ruling a single diagonal line through your work.
 - Write the page number of your alternative/additional response, i.e. See page ...
 - If you do not do this, your original response will be marked.
 - This section has seven questions and is worth 41 marks.
-

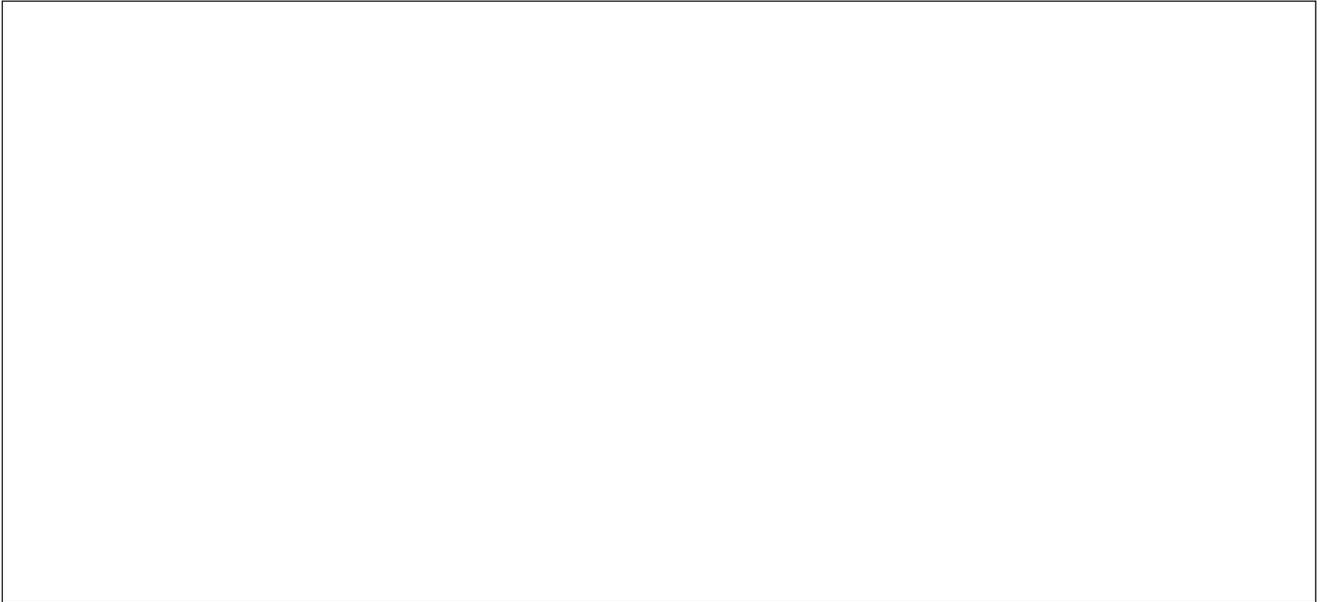
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QUESTION 11 (5 marks)

Explain the concepts of mechanical advantage and velocity ratio using a simple pulley system. Provide an annotated sketch to support your response.



Note: If you make a mistake in the sketch, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

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QUESTION 12 (4 marks)

State four industrial applications for carbon steel with 0.15% to 0.30% carbon content.

- 1. _____
- 2. _____
- 3. _____
- 4. _____

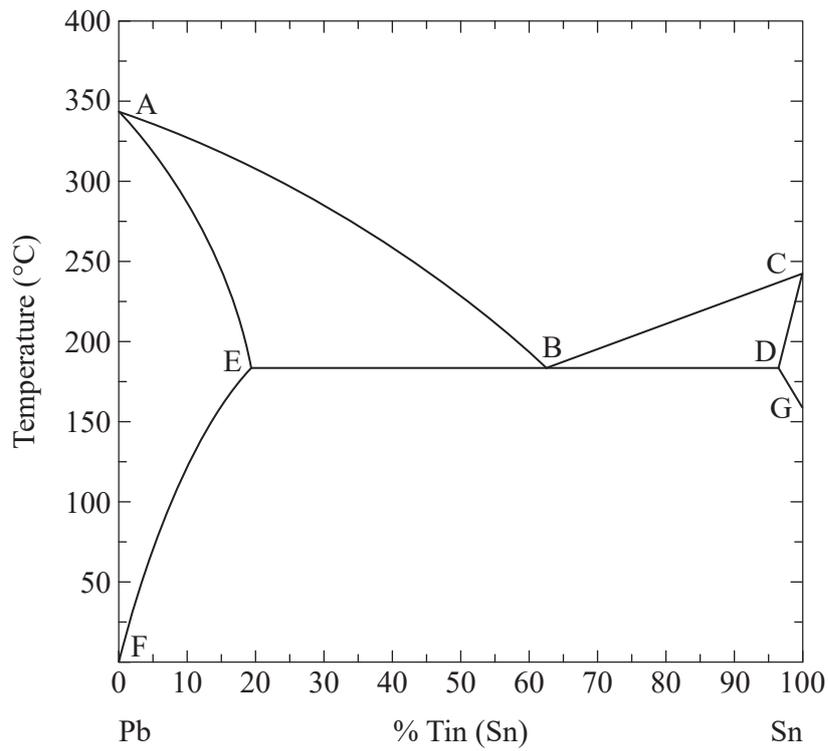
QUESTION 13 (5 marks)

Describe the function of a NAND gate. Include a truth table to support your response.

Note: If you make a mistake in the truth table, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

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QUESTION 14 (6 marks)



Use the information included in the lead–tin thermal-equilibrium phase diagram to identify each key feature.

I) solidus line _____

II) liquidus line _____

III) eutectic point _____

IV) eutectic temperature _____

V) maximum solubility of lead in tin _____

VI) maximum solubility of tin in lead _____

Do not write outside this box.

QUESTION 16 (10 marks)

The ceiling fans in a meeting room operate on demand. When staff access the room using a swipe card and the temperature in the room is above 25° C, the fans turn on, activating a one-hour timer. The fans then turn off after one hour of operation, unless a movement sensor is activated, resetting the timer to keep the fans on for another hour.

Analyse this information to create a logic circuit that meets the requirements for ceiling fan operation. Clearly identify all inputs and outputs.

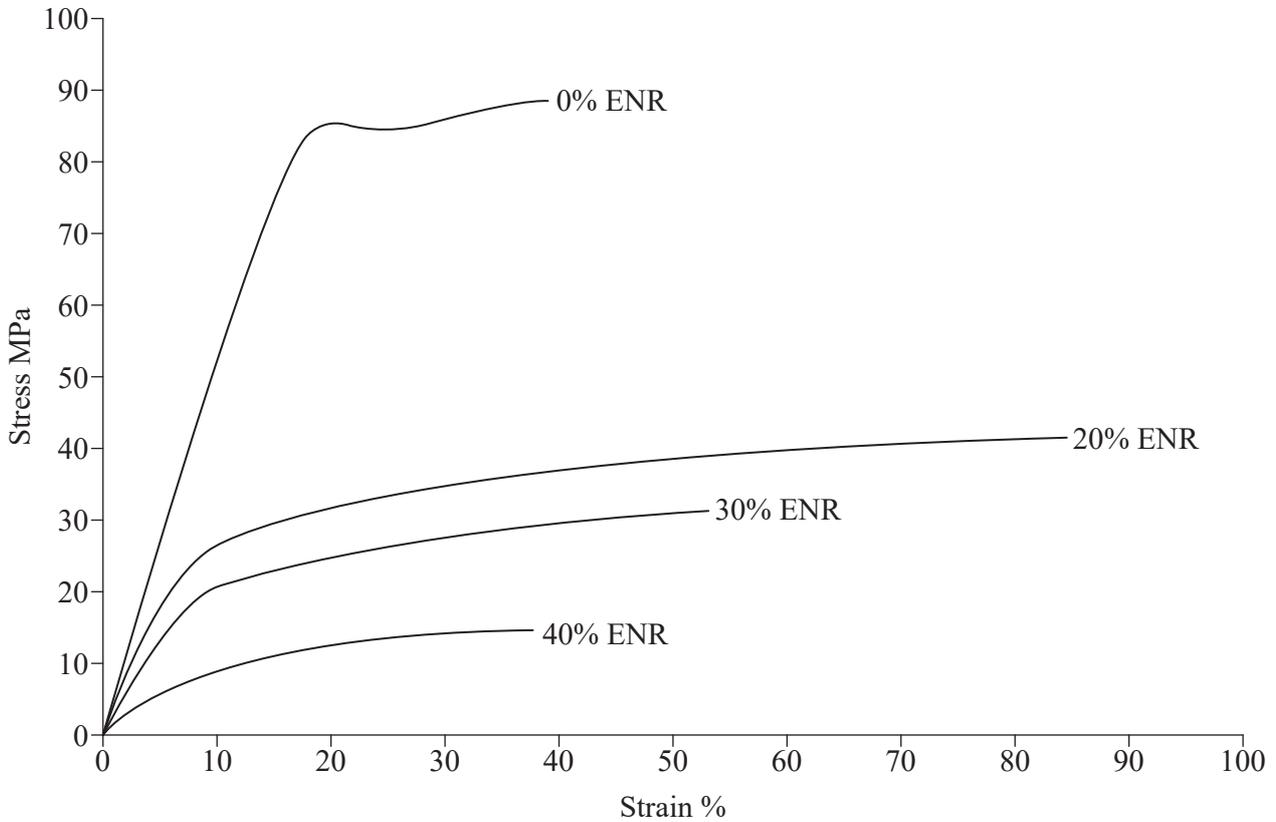


Note: If you make a mistake in the logic circuit, cancel it by ruling a single diagonal line through your work and use the additional response space at the back of this question and response book.

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QUESTION 17 (5 marks)

Nylon can be used in the manufacture of industrial gears. The stress–strain diagram indicates the effect adding epoxidised natural rubber (ENR) has on the mechanical properties of nylon.



Interpret the data to explain how adding different percentages of ENR to nylon influences its effectiveness for gear manufacture. Include four relevant mechanical properties to support your response.

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Section 3

Instructions

- Respond showing full working for calculations.
 - This section has five questions and is worth 34 marks.
-

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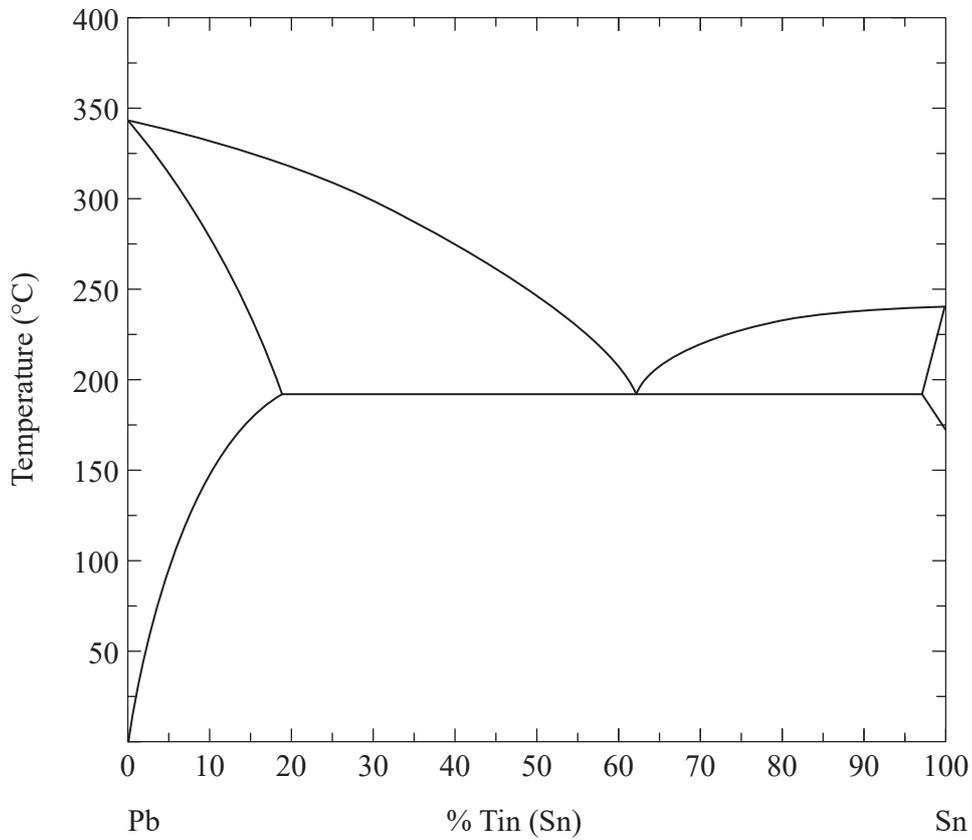


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QUESTION 21 (5 marks)

Determine the percentage of the liquid components for an alloy containing 65% lead at a temperature of 250° C. Annotate the lead–tin equilibrium phase diagram as part of your response.



Note: If you make a mistake in the diagram, cancel it by ruling a single diagonal line through your work and use the additional response space on page 25 of this question and response book.

Do not write outside this box.

ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.



ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.

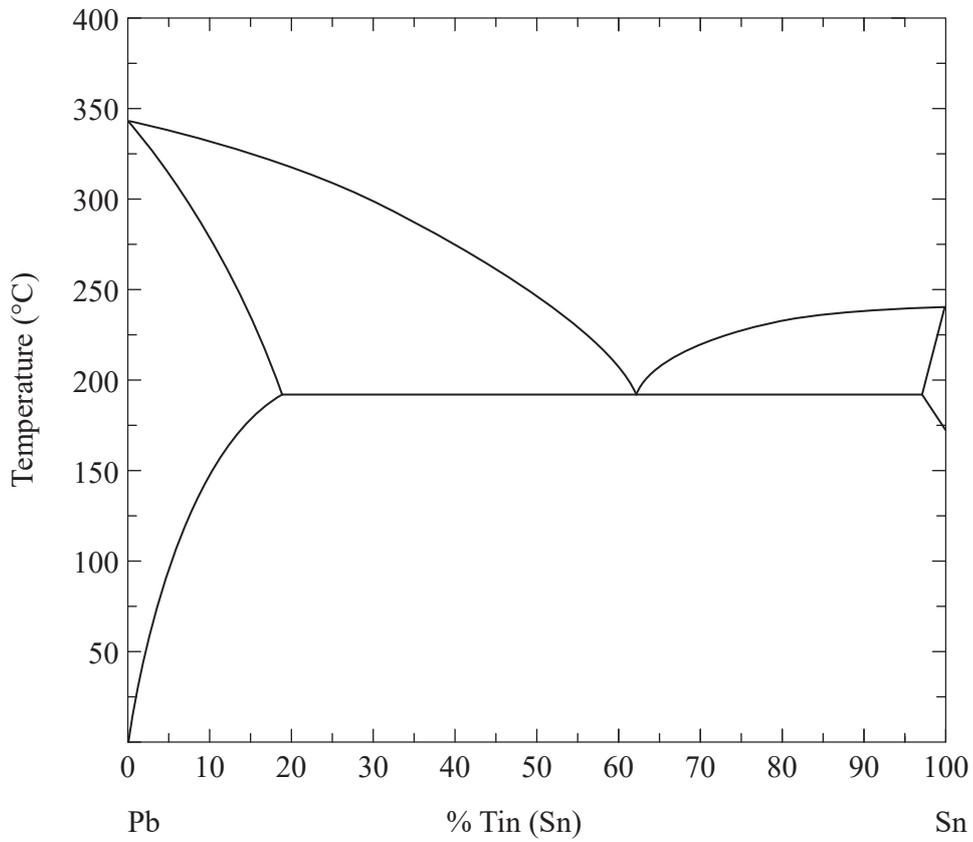
ADDITIONAL PAGE FOR STUDENT RESPONSES

Write the question number you are responding to.

Do not write outside this box.

ADDITIONAL RESPONSE SPACE FOR QUESTION 21

If you want this diagram to be marked, rule a single diagonal line through the diagram on page 15.



Do not write outside this box.

References

Question 17

Adapted (QCAA has labelled the top line '0% ENR) from Fig 2 in Tanrattanakul, V, Sungthong, N and Raksa, P 2008, 'Rubber toughening of nylon 6 with epoxidized natural rubber', *Polymer Testing*, vol. 27, issue 7, pp. 794–800, <https://doi.org/10.1016/j.polymertesting.2008.05.013>

Question 20

Adapted from:

Igiritam 2015, 'Which diesel generators have make resale value?', *Wikimedia Commons*, https://commons.wikimedia.org/wiki/File:Which_Diesel_Generators_Have_Make_Resale_Value%3F.jpg, CC BY 4.0

Игоревич 2009, 'Old engine-generator AB-2', *Wikimedia Commons*, https://commons.wikimedia.org/wiki/File:Old_engine-generator_AB-2.jpg, Public domain

Prolineserver, T 2006, 'Four pulleys', *Wikimedia Commons*, https://commons.wikimedia.org/wiki/File:Four_pulleys.svg, CC BY 3.0

Question 22

Inspired by KevinHannessen 2016, 'Inclined-belt conveyor', *Wikimedia Commons*, https://commons.wikimedia.org/wiki/File:Inclined-belt_conveyor.jpg, CC BY 4.0

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